

CLAIMS

1. Process for making a film of gallium nitride (GaN) starting from a substrate, by depositing GaN by vapour phase epitaxy, characterised in that the GaN deposit comprises at least one vapour phase epitaxial lateral overgrowth (ELO) step, and in that at least one of these ELO steps is preceded by etching of openings:

- either in a previously deposited dielectric mask,

- or directly in the substrate,

and in that an asymmetry is introduced into the dislocations environment during one of the ELO steps so as to cause the largest possible number of dislocation curvatures, since curved dislocations do not emerge at the surface of the GaN layer thus obtained.

2. Process for making a film of gallium nitride GaN according to claim 1, characterised in that asymmetry is induced:

(1) by varying growth parameters either by applying an electric field perpendicular to the growth axis, or applying a magnetic field, or by illuminating using a lamp producing UV radiation at about 170 to 400 nm, to cause preferential growth of a single family of facets {11-22}, or

(2) by making openings with unequal widths or with unequal geometry, either in the dielectric mask or directly in the substrate to apply geometric shapes to the GaN patterns to facilitate the curvature of dislocations.

3. Process according to claim 1 or 2, characterised in that asymmetry is introduced by making openings either

in the dielectric mask or directly in the substrate, that are adjacent, unequal and asymmetric forming a basic pattern of a periodic network, the basic pattern comprising at least 2 openings.

5 4. Process according to claim 3, characterised in that the openings are lines, hexagons, triangles or a combination of these openings.

10 5. Process according to claim 3 or 4, characterised in the periodic network extends along the [10-10] direction.

6. Process according to any one of claims 1 to 5, characterised in that epitaxial lateral overgrowth (ELO) step(s) is (are) made by vapour phase epitaxy from chlorides and hydrides (HVPE), by OrganoMetallic
15 pyrolysis in Vapour Phase Epitaxy (OMVPE), or by CSVT (Close Space Vapour Transport).

7. Process according to any one of claims 1 to 6, characterised in that the epitaxial lateral overgrowth (ELO) step(s) are done along one of the C(0001), M(1-
20 100), A(11-20), R(1-102), S(10-11) and N(11-23) planes of the substrate.

8. Process according to any one of claims 1 to 7, characterised in that the substrate is chosen from among sapphire, ZnO, 6H-SiC, 4H-SiC, 3C-SiC, GaN, AlN, LiAlO₂,
25 LiGaO₂, MgAlO₄, Si, HfB₂ or GaAs.

9. Process according to claim 8, characterised in that the substrate is a sapphire substrate.

10. Process according to any one claims 1 to 9, characterised in that the gallium nitride is doped during
30 at least one epitaxial lateral growth in vapour phase using a doping substance that can be chosen from among

magnesium, zinc, beryllium, calcium, carbon, silicon, oxygen, tin and germanium.

11. Process according to any one of claims 1 to 10, characterised in that an isoelectric impurity such as In, Sc, Sb, Bi is introduced in the gallium nitride.

12. Process according to any one of claims 1 to 11, characterised in that the openings are etched in a dielectric mask.

13. Process according to claim 12, characterised in that before deposition of the dielectric mask, a GaN base layer is made by vapour phase epitaxy from chlorides and hydrides (HVPE), by OrganoMetallic pyrolysis in Vapour Phase Epitaxy (OMVPE), or by CSVT (Close Space Vapour Transport).

14. Process according to claim 13, characterised in that the formation of the GaN base layer comprises the following steps:

- deposition of silicon nitride with a thickness approximately equal to one atomic plane,
- deposition of a GaN buffer layer,
- high temperature annealing at between 950 and 1120°C, such that the buffer layer changes from a continuous layer to a discontinuous layer formed of GaN patterns in the form of islands, then,
- deposition by epitaxy of GaN.

15. Process for making a film of gallium nitride (GaN) according to any one of claims 12 to 14, characterised in that the process comprises two separate vapour phase epitaxial lateral overgrowth (ELO) steps, the GaN deposition during the first step is made in the GaN zones located in the openings, and the GaN deposition

during the second step leads to lateral overgrowth until coalescence of the GaN patterns.

16. Process according to claim 15, characterised in that the GaN deposition during the first step is made under growth conditions such that the growth rate along the $\langle 0001 \rangle$ direction is greater than the lateral growth rate, and the GaN deposition during the second step is made under modified experimental conditions such that the lateral growth rate is greater than the growth rate along the $\langle 0001 \rangle$ direction so as to obtain full coalescence of the patterns.

17. Process according to claim 16, characterised in that the modification of the growth conditions to obtain a lateral growth rate higher than the growth rate along the $\langle 0001 \rangle$ direction consists of adding magnesium, antimony or bismuth.

18. Process according to any one of claims 1 to 11, characterised in that the openings are directly etched in the substrate.

19. Process according to claim 18, characterised in that this process is implemented according to operational conditions described in claims 14 to 17.

20. Gallium nitride film, characterised in that it may be obtained using a process according to any one of claims 1 to 19.

21. Gallium nitride film according to claim 20, characterised in that it has a thickness of between 1 and 20 μm .

22. Optoelectronic component, characterised in that it is made from a GaN film according to either claim 20 or 21.

23. Laser diode, photodetector or transistor, characterised in that it is made from a GaN film according to either claim 20 or 21.